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YOUNG & THOMPSON
209 Madison Street
Suite 500
Alexandria, VA 22314

EXAMINER	
PADGETT, MARIANNE L	

ART UNIT	PAPER NUMBER
1715	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

DocketingDept@young-thompson.com

Office Action Summary	Application No.	Applicant(s)	
	10/585,245	KASAMA ET AL.	
	Examiner	**Art Unit**	
	MARIANNE L. PADGETT	1715	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 August 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

1. Applicants' **8/31/2010 amendment** has clarified some claim nomenclature removing previous ambiguities, and has added several limitations. Applicant's amendment to the specification has corrected typographical errors as noted in [0082], in section 4 of the action mailed 3/31/2010.

On page 15 of their response, applicants have cited figure 1 & paragraphs [0060], [0064] & [0167] to support the amendment to claims 1, 16 & 17that adds "wherein the direction of the applied magnetic field is from the plasma generation means to the deposition substrate"; however [0167] does not exist in the scanned copy of the original specification, plus figure 1 & the description of FIG.1b starting on [0060] (full description [0060-63]) or the descriptions of FIG.2(a) starting on [0064] are both for a particular configuration for *in-situ* plasma generation; but there is no required configuration in the claims, which as written both include & suggest remote plasma generation, where the plasma generation means may be essentially any where, thus this support is entirely insufficient for the claims ***as written***. The examiner found no citation of support for applicants' claim of "generating continuously... plasma", nor their requirement for the bias voltage to be "DC".

The examiner notes that the apparatus figures, plus [0061], [0065] & [0067] provide support for a specific configuration, where plasma generation is confined a vacuum chamber (21 or 41), having a flow path between electrodes in the axial direction of the chamber, **as illustrated**, which axial direction is also along the magnetic field direction formed by electromagnetic coil 23 or (47+48) or 43, that surrounds these illustrated chambers.

The examiner notes dependent claim 14 as amended is essentially defining the "deposition substrate" to be plural substrates which are plates & those plates are circular, described as "having concentric circle shapes", where concentric with respect to what is not defined.

With respect to the amendments to claim 18, while still phrased as a method limitation for further describing an apparatus claim (i.e. the substrate is **not** part of the apparatus & its movement is not part of

the apparatus), however the action described does suggest a capability that can be considered to be ascribed to the apparatus, although it is not necessarily or positively required as presently written.

2. **Claims 1-21** are rejected under 35 U.S.C. **112, first** paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Apparently no support was cited for "continuously" with respect to the plasma generation, or with respect to "DC" now describing bias voltage applied to the substrate. However, it is noted that [0057] discusses applying a bias voltage of -1V, which may be considered ***an example*** of a DC voltage, but *no generic disclosure* of employing DC bias voltages was found. A single example by itself, lacking any discussion on why the disclosure would necessitate a generalization from the single example, does not provide adequate support for generically claiming a processing technique, hence the generic claim of employing DC bias voltage in the present broad claimed scope is considered to encompass **New Matter**. See independent **claims 1, 16 & 17**. The examiner notes that Ref. #12, 30, 58, 70 described as "bias voltage application oriented power supply" have circular symbols frequently employed for indicating RF power, but are not so labeled; while ref. #84, 93, 106, 124, 131 & 154 have a 2 line configuration frequently used to indicate direct current, are identically named, with neither ever identified as being a particular type of power source, so if one interprets these symbols as a disclosure of their typical meaning, the disclosure can only apply to the specific apparatus configuration with which they are illustrated, as they are never actually discussed specifically or generically. Thus, no benefit or affect or necessary use of either particular power source that *might* be intended was found in the original specification.

With respect to continuous plasma generation for the class of all possible plasma apparatus, **no** actual disclosure of continuous plasma generation was found, but in figures 7 & 8, as discussed in [0038], item 10 on page 17, reference #148 & [0084] that discusses figure 7, a **continuous processing system** is

taught, which has a conveyor for a "continuous substrate", such that plasma causing ion implantation is applied simultaneously with deposition, the two actions occurring at different locations as illustrated in the figures. <u>However</u>, this disclosure does <u>not actually say that the plasma itself is continuous</u>, as opposed to a pulsed plasma, which could also be continuously applied to a substrate being continuously conveyed passed it. The claim language for "generating continuously... plasma" excludes employing pulsed plasma generation, however the support in the specification is not directed to continuous plasma generation, but continuous processing which is an entirely different concept, which encompasses the use of pulsed or continuous plasma, since one may continuously process a continuous substrate using pulsed plasma or a continuous plasma, thus the examiner found no support for the claims as amended with respect to necessitating continuous plasma generation & thus excluding pulsed plasma. Hence, this amendment <u>encompasses</u> **New Matter**, as requiring a technique not found to be necessitated or explicitly discussed in the original specification.

With respect to the requirement that "transporting the plasma onto a deposition substrate under an influence of a magnetic field, wherein the direction of the applied magnetic field is from the plasma generation means to the deposition substrate", assuming that "a magnetic field" & "the applied magnetic field" are the same fields (*not necessitated by antecedents due to inconsistent terminology*), the specification only provide support for this in the specific configuration as illustrated in figures 1-2 & 7, where there is only one chamber, with the electromagnetic coils creating a magnetic field that is aligned with the chamber axis, with hot plate & substrate support that are essentially electrodes at the two ends of the axis. However, applicants' claims encompass remote plasma generation, where the location of generation the plasma can be anywhere with respect to the substrate, thus aligning the magnetic field with respect to two locations whose relative locations are undefined in the claimed process, is broader than the scope of the enabling disclosure, thus lacks support in the original specification, thus also encompasses

New Matter. (*Note there is no support for use of two different magnetic field is, thus that possibility created by the lack of clear antecedents is also New Matter*).

In **claim 6**, applicants have deleted "comprising fullerene" as a description of "the material film" and now claimed that the ion implantation produces "containing fullerene or hetero-fullerene within the material film", which as amended is not previously required to contain any fullerene whatsoever, which does not appear to be supported in the specification (see [0080-81], [0111-112] & [0015] & further discussion below in section 3), where the film being implanted is described to be a fullerene film before implantation, thus claim 6 as amended also encompasses **New Matter**, since it claims forming fullerenes or hetero fullerenes where no fullerenes nor even any carbon were previously required to be present, via implantation of generic ions (i.e. how does one create fullerene without any necessary source of C for fullerene construction?).

With respect to **claim 14** as amended, if the described "a plurality of divisional deposition plates having concentric circle shapes" is intended to be supported by figures 6(b-d) & its description in [0081], this disclosure only has peripheral plate 127 & central plate 126, only one of which has a circular shape & the other is annular, lacks descriptions of reference numbers in (c) & (d), and definitely does not support an unlimited number as encompassed by "a plurality", thus the support for this claim as amended is unclear, and lacking a clear showing of necessary support must be considered to encompass New Matter. Also see clarity discussion below.

3. **Claims 1-21** are rejected under 35 U.S.C. **112, second** paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In independent **claims 1 & 16-17**, have added the limitations of "**the** direction of **the** applied magnetic field" (emphasis added), in lines 9, 8-9 & 8-9, respectively; however neither of these terms have any antecedents, as no previous limitation necessitated any direction or respective locations for the

substrate & the applied magnetic field. Also, the nomenclature "applied magnetic field" is inconsistent with the previously introduced "a magnetic field". Assuming from the cited support (discussed above), only one magnetic field is under discussion, applicants should either drop the "applied" from the second term or added it to the first term, but clearly claimed relative locations of the plasma generation means & substrate with respect to each other, are necessary for the direction of any magnetic field defined with respect to them to be clear with respect to the process.

It is noted that the action in **claim 1** of "transporting the plasma **onto** a deposition substrate..." (emphasis added) totally encompasses "irradiating the plasma towards the deposition substrate", since one cannot transport a plasma onto a substrate unless it is traveling in the direction towards the substrate, & the plasma itself is by definition a form of irradiation or radiation. *On the other hand*, the further limitation of "implanting the implantation ions **into a material** on the deposition substrate" (emphasis added) created some confusion with respect to the transporting step, in that it is unclear whether the plasma impinges directly on the substrate surface or onto a film on the substrate surface, as the claim appears to require both at the same time from the same plasma; i.e. in the independent claim 1, it is unclear if "the material film" is part of a composite substrate, called "a deposition substrate", or if it is deposited thereon, sometime during or after the transporting step, but before the implanting step. For the claims *as written*, any possible option suggested by the claim language will be considered for evaluation with respect to the prior art.

In dependent **claim 5**, exactly what has been required to be repeated **remains** unclear, since "a step of depositing **a material film** on the deposition-assistance substrate" (emphasis added) does not use an article showing antecedent basis to the "a material film" introduced in the independent claim, but neither is the dependent claim limitation differentiated therefrom. Thus, it remains unclear whether or not claim 5 is defining where "a material film" introduced in the independent came from, or if it is introducing an entirely different film. Also, it remains uncertain whether this limitation is intended to

require the process of claim 1 to be repeated on different parts of the substrate (i.e. on a "continuous" substrate, or on different localized portions individually treated or patterned, etc.), or is forming a multilayered structure with multiple deposited films stacked on each other or on opposite sides of the substrate, where the film material may or may not be the same The present phrasing remains ambiguous with respect to the independent claim from which claim 5 depends. Note, any possible meanings may be considered with respect to the prior art.

In **claim 6**, the amended requirement that "the ions are implanted into the material film **to produce containing-fullerene** or hetero-fullerene within the material film", while an improvement, is still vague & indefinite, since what is produced is not clearly stated, i.e. what is meant by "**to produce containing-fullerene**"? The phrasing of this claim limitation is nonidiomatic English that does not have a clear relationship to its amended alternative "or hetero-fullerene within the material film". In reviewing applicants' specification in an attempt to determine intended meaning & support for this claim as amended, the examiner notes with respect to figure 6, [0080], on page 40 says that the implantation is into a fullerene film 123 deposited on substrate 122, thus the fullerene film is present before implantation. At the end of paragraph [0080], after discussing ion density is with respect to ion implantation the specification makes the confusing statements that "thereby decreasing a yield of containing-fullerene in the fullerene film along a periphery of the deposition-assistance substrate", thus the specification uses the same nonidiomatic & unclear language, such that this teaching does not provide any clear indication of what "containing-fullerene" encompasses on its own, especially considering that the original film was all fullerene, which could hypothetically mean that the ion implantation is decomposing the fullerene, as opposed to forming, but this teaching of the specification does not actually say. Similarly, the end of [0081] discloses "densities of ions to be implanted are made more uniform at fullerene films 128 and 129, thereby enabling improvement of a yield of containing-fullerene", which also starts out with a fullerene film and after implantation has a "yield of containing-fullerene", which is nonidiomatic & of unknown

scope, with no clear teaching on what the implanted ions do to the original fullerene film, except that there is at least some fullerene still present, but what an "improvement" is, cannot be determined from this teaching. Further discussion in [0111-112] & [0115] does not provide clarification with respect to scope of "containing-fullerene" & appears to indicate that "hetero-fullerene" is formed by substitution of carbon atom(s) in already deposited fullerene films, thus in neither case is fullerene being disclosed as being formed by the ion implantation, only somehow modified, either unclearly as "containing-fullerene" or clearly as "hetero-fullerene".

Claim 14, as amended, requires "the deposition substrate in a form of a plurality of divisional deposition plates having concentric circle shapes", however if each plate is a circle, i.e. a disk, it is unclear what each circle is concentric with, but could possibly read on a plurality of the disk substrates arranged in concentric circles. Alternatively, applicants could intend an arrangement as depicted in FIG. 6(b-d), which appears to probably show an annulus 133 or 135, arranged concentrically to disk 132 or 134, which are presumably arranged on a peripheral plate 127 & central plate 126, respectively, however [0081] that discusses these figures does not define the reference #132-135, nor does this set of figures & their scanty description provide for a plurality, since while to is a plural number, it does not support the generic "plurality" that is every number greater than one, thus making attempting to read in light of the specification ineffective.

In **claim 18**, which depends from independent apparatus claim 16, applicant is describing the movement of a substrate, however a substrate treated in an apparatus, is not considered to be a physical part of the structure of the apparatus, and nothing in this dependent claim requires that the limitations of "a conveyor" or "rotary cylinder" be a part or in any way necessarily connected to the apparatus being claimed, as the action of conveying the substrate via the two named means may or may not occur within the apparatus, since as noted the substrate is not an integral part of the apparatus, thus has existence outside of the apparatus & the substrate being conveyed can occur at any time.

4. The **disclosure** is **objected** to because of the following informalities: the specification appears to be missing descriptions of some reference numbers, such as 132, 133, 134, 135, as noted above. Proofreading to ensure all reference numbers are appropriately described & for correction of nonidiomatic and unclear English is recommended.

Appropriate correction is required.

5. The following is a quotation of the appropriate paragraphs of **35 U.S.C. 102** that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

It at The following is a quotation of **35 U.S.C. 103(a)** which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The **nonstatutory double patenting rejection** is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226

(Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

6. The rejection of **Claims 1-5, 9 & 16-17** under 35 U.S.C. **102(b)** as being clearly anticipated by **Miyake Koji et al**. (JP 2000-012285), is overcome by the requirement that a continuous plasma be employed, as the plasma is of Koji et al. are pulsed plasmas. <u>However</u>, if the above discussed new matter with respect to the claim of "generating continuously... plasma" is merely removed, for the claims as otherwise written, the 102(b) rejection over these claims would be reinstated, as Koji et al. teaches a magnetic field consistent with the claims as presently amended & employs a DC bias on the substrates.

7. **Claims 1-5, 9-14, & 16-21** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Miyake Koji et al**. (JP 2000-012285), in view of **Yamashita Mutsuo** (JP 2003-313662), <u>optionally</u> considering **Ohmoto et al**. (2001/0019881 A1) with respect to claim 14.

Miyake Koji et al. (English abstract & figures 3-8) teach ion implanting negative hydrogen ions into a substrate, which as illustrated in figure 8 is a coated substrate, where the plasma is taught to contact the substrate, with the apparatus of drawings 4-7 providing examples of different magnetic field (B) influences employed in various plasma processes process, all contacting (e.g. transporting the plasma onto substrate) the substrate with plasma, where the examiner notes that the electric coil 105 illustrated in **drawing 7** would inherently create magnetic & electric fields while voltage has passed therethrough; while **drawing 6** explicitly shows a **magnetic field (B)** in the claimed **axial configuration** which is made by external coil 90 instead of the analogously positioned intro coil 105, thus demonstrating claimed

magnetic field direction in either of Koji et al.'s drawings 6 or 7. Note that generically, any gas inlet is a means capable of supplying deposition material & implanting a surface of a substrate creates a surface film, thus all Koji et al.'s apparatus options fits the *generic* meaning of the present apparatus claims deposition means. All of drawings 2-7 & 9 illustrate bias power means (44, 77, 96, 115 or 222) attached to substrate for supplying positive bias in order to attract negative ions, employing a symbol that generally represents a DC power source, the figure 3 illustration of positive bias voltage 54 appears to indicate a pulsed DC current due to its configuration & discussion on [0052], thus while not using the words DC bias voltage, the taught single value positive bias voltage supplied in combination with using only the symbol for DC power sources may be reasonably considered to teach employing the now claimed DC bias voltage. However as noted above Koji et al. (JP)'s implantation process differs by employing a pulsed plasma instead of a continuous plasma.

As previously discussed, the **machine translation** of **Koji et al.**, which provides further discussion supportive of the English abstract and describing examples & drawings, however the examiner noted various this translations or misnomers, where it appears that implants, implanted & implanting have been mistranslated as "pores", "poured" & "pouring"; while translations stating "putting out the lights" appears to be used in a context which would mean -- turn off --; "point light state" appears to be being -- on state -- or -- turned on --; and "hydrogen content child" or "...children" appears to mean -- H_2 dissociation products or species -- or the like. This is not a complete listing of machine translation problems, but should make the reference easier to follow.

Particularly note drawing 4 is discussed on [0060+] with respect to Ex. 2, and has magnetic field influences from both permanent magnet 71 & conductive bar structure 69, such that the plasma that flows through the bar structure to the wafer 72 substrate, excludes the high-energy electrons, but not the low energy electrons, thus influencing the plasma flow. The plasma is formed using hot filament 64, and the substrate is positively biased with power source 77, where both of plasma and bias are pulsed as shown in

drawing 3 discussed in [0052-58]. It is noted that all of the examples & apparatus are discussed with respect to pulsing as illustrated in drawing 3. Drawing 5 is discussed in Ex. 3 in [0073]; drawing 6 in Ex. 4 in [0074+], while Ex. 5 discusses drawing 7 in [0077+], with the H^- ion implantation process that may be performed by any of this apparatus, as illustrated in figure 8(1) discussed on [0084+].

Example 5 employs cesium vapor from oven 117 directed at target electrode 101, which is involved in a sputtering process with hydrogen and rare gases (Xe), so as to control the hydrogen ion charge species, where [0083] notes that Cs is deposited or shallowly implanted on the substrate surface, which even though for their specific process it is intended to be later removed, it still constitutes a deposition during processing, hence simultaneously with the overall ion implantation process, where since the process is also pulsed, the entire process implantation & deposition may be considered to be repeated with each pulse cycle. Note that the oven vapor supply structure of drawing 7 is consistent with applicants' apparent 112, 6th paragraph meaning with respect to "material film deposition means for..."

While Koji et al.'s process is primarily directed to pulsed bias means for H^- ion implantation, with the ion implantation technique's specific use in creating silicon-on-insulator (SOI) structures, mention is made in [0009] of such structures usefulness with respect to solar cells, thus layers formed & deposited in the process are considered to include "a material film of solar cell".

While Koji et al. does not appear to teach specific ranges of acceleration energies (i.e. implantation energies) for their hydrogen ions (or Cs ions) that may be implanted via their process, nor discuss the parameter of ionic current density, it would've been obvious to & reasonably expected for one of ordinary skill in the art to optimize acceleration energy & ionic current density dependent on desired depth of ion implantation & desired dose, in combination with other plasma parameters which affect these results, since acceleration energy = implantation energy of a particular ion species when impinging on a particular substrate material will provide characteristic implantation depths, which may also be modified by parameters such as substrate temperature. It is further noted that as applicants' claims are silent with

respect to types of ions, & mostly vague with respect to specific materials being implanted (claim 9), etc., the claims lack sufficient context to provide significance to specific implantation parameters.

With respect to **batch processing** of plural substrates versus the single substrate discussed in the examples of Koji et al., configuring apparatus for batch processing versus single substrate is an obvious variation in processing, old and well-known to those of ordinary skill in the art and desirable to employ for mass production purposes, thus an obvious variation on the teachings of Koji et al., especially considering discussion of the above process that makes scanning of ions to be implanted across a substrate unnecessary ([0030], [0034-36], etc.). Hence, whether a batch of plural substrates are mounted on a conventional planetary (rotating) support for multiple substrates, where each substrate may be rotated into the plasma zone, <u>or</u> multiple substrates are treated simultaneously, it would've been obvious to one of ordinary skill in the art for the biasing of the specific substrate to be individually controlled, since in either case it is only the substrate that is desired to be ion bombarded & implanted, not surrounding holder structure, which if extensively ion bombarded could produce sputtering contamination in the chamber &/or cause harm to the structure itself. Thus, it would've been reasonable for a competent practitioner to selectively direct the ion bombardment, hence the biasing to only the (those) substrate(s) being implanted at that time & only biasing the substrates themselves. Also note that such rotate a full substrate holding platforms may conventionally be disk shaped, which is a very short or thin cylindrical shape.

<u>Optionally</u>, one of ordinary skill in the art would have been aware that when large area or multiple substrates are biased in plasma processing, that uniformity & distribution problems may arise for particular configurations, however it is old and well-known to compensate for such uniformity issues with various biasing configurations dependent on particular substrate requirements such that one of ordinary skill would reasonably have been expected to employ such techniques so as to provide desired delivery of plasma density to multiple substrates or all locations on a "substrate". Such a technique is demonstrated

by **Ohmoto et al**. ((881): figures 2 & 7; [0015-17] & [0033-37]) with respect to a Si wafer surrounded by an annular reign of Si, which are individually biased in order to control ion bombardment during plasma processing, hence it would've been obvious to one of ordinary skill in the art to employ biasing techniques as taught in Ohmoto et al. (881) to other plasma processes requiring ion bombardment on biased substrate(s), including employing analogous substrate & bombarded surface shapes, as appropriate. Note that any surface which the plasma processing techniques bombards, thus treats, may be termed a substrate.

While Koji et al. does not discuss specific holding means employed in securing substrates two substrate holders, such as the claimed "electroconductive clamp member", it is old and well-known to employ electrostatic clamping structures with silicon substrates as contemplated to be treated by the process of Koji et al., hence it would've been obvious to one of ordinary skill in the art to use such conventionally employed structures in any of the apparatus as depicted by Koji et al., as they would have reasonably been expected to perform their standard function with respect to typically electrostatically clamped substrates, where the examiner additionally notes that any electro-static clamping structure will necessarily have something that may be called ‘an electroconductive clamp member’.

Koji et al. does not discuss using **a continuous plasma** for their ion implantation process, nor an apparatus employing **a grid electrode** to control the plasma potential, where such a grid electrode is separately positioned from the substrate, however **Yamashita Mutsuo**, who teaches a sputtering apparatus (drawing 1, [0026-38] in machine translation) substantially similar to the apparatus of Koji et al.'s drawing 7, including employing two opposing electrode structures, a surrounding the HF coil & DC biasing of the substrate holder ([0034]), although the apparatus optionally may employ ground or RF biasing if needed in alternative processing, except that Mutsuo does not pulse their plasma & additionally employs a grid electrode 4 ([0030], also illustrated in drawings 2, 3 & 4). The grid electrode is also called

a plasma grid shield; is used to increase the plasma density during plasma generation with the high-frequency antenna coil 3; and is used for controlling the energy of ionized particles directed at substrate 5, hence it would've been obvious to one of ordinary skill in the art that the grid electrode as illustrated in Yamashita Mutsuo is an effective tool for providing additional control of the plasma conditions, including when using continuous plasmas. In other words, the plasma potential, of the analogous plasma directed towards substrates, particularly the analogous sputter apparatus configuration employed in Koji et al.'s drawing 7, particularly considering that one of ordinary skill in the art would reasonably have desired the maximum control & versatility with respect to ion energy, plasma conditions & direction of ions into the substrate, for ion implantation as taught, thus the mesh grid electrode 4 would have reasonably been expected to supply such additional control given the effects discussed as provided thereby by Yamashita Mutsuo, as well as teaching means of employing this apparatus configuration in a plasma process that is continuous, which one of ordinary skill in the art would reasonably have considered advantageous for the ability to affect deposition rates, especially in combination with the grid structure’s additional control & noting that Koji et al. was concerned with low throughput (end of [0030]) during processing, which this techniques also address. The examiner further notes that any time that the plasma is generated, a voltage potential will be thus applied (e.g. floating potential induced by the plasma) to the electric grid, or alternatively, dependent on optimization, it would've been further obvious to one of ordinary skill in the art to apply specific voltages to the grid dependent on desired degree of effect the grid is to have on the plasma as a whole & specific negative or positive charged species therein. Specific distance of the grid electrode from the substrate would reasonably have been expected to depend on overall dimensions of the chamber, of the plasma zone, of the substrate, as well as specific substrate configuration, etc., however the distance would also reasonably have been expected to be sufficiently close in order to have the taught effects both on raising the plasma density of the plasma produced between it and the target electrode, and close enough to substrate to provide the control of the ionized particle energy of those particles on their

way to the substrate, which reasonably would have been expected to be inclusive of distances in the claimed range of 1-50 mm. *Also, while the plasmas of Koji et al. & Yamashita Mutsuo are not being employed for identical enduses, ultimate use is not the only consideration for plasmas being analogous, as the particular materials deposited are more relevant to the specific chemistry than to the physical structure of the plasma, thus for considering physical control, transport & movement of plasma species between opposing electrodes, a one of which supplies charged particles to the plasma & the other on which deposition &/or implanting occurs these references are discussing analogous plasmas.*

It is noted that Yamashita Mutsuo also discuss **water cooling** of structures in their plasma chamber on which the plasma impinges, specifically targets 2 & 10 ([0028] & [0032]), demonstrating that it is known to employ cooling mechanisms on structures exposed in the plasma which may be detrimentally affected if the plasma induces excessive heating thereof, hence dependent on specific materials employed for electrodes or substrates, with further consideration of the desired effects of implantation to be produced in the substrates, it would've been obvious to one of ordinary skill in the art to provide means for temperature control in order to prevent damage or to further desired development of microstructure, where such temperature control would reasonably have been expected by one of ordinary skill in the art to encompass either heating or cooling mechanisms, where cooling would have reasonably been expected to be more frequently employed when substrates are more sensitive to damage by high temperatures, which might be induced by ion bombardment.

8. **Claims 6-8 & 15** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Miyake Koji et al**. (JP 2000-012285)), in view of **Yamashita Mutsuo** (JP 2003-313662), as applied to claims 1-5, 9-14 & 16- 20 above, and further in view of **Watanabe Satoshi et al**. (2002-255518).

Koji et al. while specifically discussing ion implantation with respect to semiconductor substrates or also with mention of metal or insulators substrates (abstract; claim 1; [0001]; etc.), does not particularly discuss ion implantation of a substrate or of a coating that may comprise fullerene, <u>however</u>

Watanabe Satoshi et al. (English abstract; drawing 1; [0001]; & [0006-8]) provide teachings which indicate that it is desirable & known to employ ion implantation techniques on substrates having vapor deposited coating of fullerene thereon, in order to provide implantation of specific ions in the fullerene compound. Satoshi et al. employs an ion injector with mass spectrometry magnets, as illustrated in their drawing, which ion implantation equipment is analogous to the prior art ion implantation techniques discussed by Koji et al. with respect to their drawing 1, which techniques the Koji et al. process provides improvements thereover, alone or in view of Yamashita Mutsuo, as it is not necessary to scan the entire surface in order to treat the entire surface. Hence, it would've been obvious to one of ordinary skill in the art to employ plasma apparatus as illustrated in Koji et al.'s drawings, especially drawings 2 & 4, or plasma processing of drawing 7, in view of Mutsuo, as these processes provide the ability to control on an implantation as taught by Koji et al., in view of Matsuo, which would reasonably have been expected to be effective for other specific substrates than those particular demonstrated semiconductors or metals, such as Satoshi et al.'s fullerene coated substrates, with the added advantage of not needing to scan the entire surface in order to treat the entire surface. It would have been further obvious to one of ordinary skill in the art that as fullerenes are complex molecules, whose structure may be disrupted chemically at sufficiently high temperatures, to control the substrate temperature during ion implantation, so as to maintain a desirable temperature, where temperature maintenance would reasonably have encompassed substrate temperature control means inclusive of old & well-known cooling techniques, such as thermally conductive means using heat transfer media, like as water.

9. **Claims 1-6, 9, 11 & 16-18** are rejected under 35 U.S.C. **102(b)** as being clearly anticipated by **Hirata et al**. (The K^+-C^-_{60} Plasma for Material Processing").

Claims 7-8, 10, 14 & 18-20 are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al**. (The K^+-C^-_{60} Plasma for Material Processing"), optionally considering **Ohmoto et al**. (2001/0019881 A1) with respect to claim 14, as discussed in section 7.

Applicants have amended independent claim 1 to require an applied magnetic field having a configuration already present in the teachings of **Hirata et al.**, as well as employing DC bias, also already employed, plus that the plasma is generated continuously, which is considered to the typical phrasing of continuous plasma, meaning that the plasma employed during the deposition is not a pulsed or intermittent plasma, which requirement is also consistent with the teachings of Hirata et al., thus applicants amendments to the independent claims have failed to create any distinction from this reference in this claims, as will be further discussed below in the context of the previously presented discussion.

Hirata et al. (abstract; figures, esp. 1-6; last ¶ of Introduction on p. 288; Conclusions p. 292) teach a plasma source having a K^+ plasma column **confined by a strong axial magnetic field**, into which Buckminster fullerene particles are injected, such that large negative C^-_{60} ions **deposit on substrates**, **while being bombarded by potassium ions**, to form conductive deposits of K-C_{60} compound, which may be considered to be <u>a coating of fullerene implanted with potassium</u>. Hirata et al. suggest that such C_{60} based films usefulness in functioning as alkali fullerides & polymers, where the examiner notes that fullerene compounds are generally conductive & due to their highly cross-linked structure, considered a species of polymer. Hirata et al. teach 5 substrates on a translatable substrate holder, where each substrate's bias voltage may have <u>individually controllable external</u> **DC biasing applied** thereto (FIG. 1; ¶ bridging p.289-290; 1st col., p.91), where tests using applied voltages include negative voltages (e.g. -10 V) applied to the substrate (figures 3 & 5). Hirata et al. measure various plasma [ion] densities with a Langmuir probe, including electron, K^+, C^-_{60} densities (1st ¶ experimental results on p. 290, & figure 2), where I_{s+} indicates the positive saturation current, thus in figure 2 the bottom right hand curve indicates the radial profile corresponding to the ion current density of potassium, which given the scale of 0.4 μA, gives a peak height of approximately 1.2 μA, so is reasonably considered to correspond to applicants' 1 μA/cm^2 or more for the radial profiles. The energy (temperature) of the potassium ions in the plasma of this experiment is taught to be about 0.2 eV, which while not said to be the acceleration energy, would

appear to be related thereto, with it noted that the value is lower than 0.5 eV of applicants' claimed range of 0.5-500 eV, but is not significantly different therefrom 0.5 eV, especially considering Hirata et al. conclude that their "results demonstrate that fullerene-based materials such as an alkali fulleride are produced by controlling the incident fluxes and energies of alkali and fullerene ions at biased substrates" (page 292, end of 1st col.). Hence, it would've been obvious to one of ordinary skill in the art to employ different energy ranges, i.e. accelerations, for the positive ion (e.g. K or the like), with variation for particular substrate biasing voltages, using routine experimentation to optimize for different parameter variations, which would reasonably also been dependent on particular positive ions employed, as well as particular fullerene compound deposited. With consideration of employing other alkali metals than the particularly exemplified potassium, as well as different fullerene compounds, which combinations would reasonably have been expected to have different useful ranges of optimization, thus applicants' alternative ranges of 10-500 eV & 20-500 eV, would also have reasonably been considered to be within the bounds of expected useful acceleration energies, especially considering ions of different masses very in their ability to penetrate a like substrate material, thus would have been expected to have different optimized energy requirements.

Note that in the teachings of Hirata et al., deposition of the fullerene compound is occurring simultaneously with the irradiation of the plasma that bombards the deposited fullerenes compounds with K ions, and this process is performed on a set of five substrates at a time, thus may be considered to be repeated in the possible broad contacts of the present claim language. It is also noted that as appears to be indicated by applicants' claim 14, that applicants consider the equivalent of plural substrates to be one large composite substrate. Hirata et al's multiple substrate arrangement with individually controllable DC bias voltage structures differs from applicants' possibly claimed arrangements in that Hirata et al.'s is a linear structure, while applicants claim a configuration that might read on a concentric circle of a plurality of flat substrates disks or a disk with one or more annular plates concentrically surrounding (i.e. "a

substrate in a form of a plurality of divisional deposition plates having concentric circle shapes", see above 112's), however the Hirata et al. article's is an experimental discussion of this technique, where their radial profiles, as illustrated in figures 5 & 2, suggests that different distances from the radial center of the plasma will produce different conductance in the deposits on the substrates, thus it would've been obvious & reasonable for one of ordinary skill in the art, when performing batch processes in the taught apparatus that are intended to be used for production purposes, rather than experimental research, to place &/or bias all substrates so as to achieve equivalent plasma exposure for each surface in the plasma, hence the experimental data showing differential results with respect to radius would clearly & reasonably suggest to one of ordinary skill & competence to have the substrate(s) concentrically placed about the axis of the plasma column with bias optimize with respect to location & desired implantation &/or deposition density, to insure even or varied exposure as required for the particular enduse. Furthermore, use of substrate movement that insures equivalent exposure, such as rotation of planetary arrangements of substrates (i.e. suggestive of a conveying meaning ≡ conveyor, including a rotary cylinder or disk configuration), especially considering that such techniques are typical & conventional in the plasma & vapor arts, would have been further obvious for effecting such optimization as suggested by these teachings. <u>Optionally</u>, **Ohmoto et al**. (881), discussed above, particularly discusses means of controlling ion bombardment distribution from plasma employing a composite bias electrodes structure, with a central biased disk supporting a Si wafer, surrounded by separately biased angular structure(s), with a Si ring thereon & immediately adjacent & surrounding the Si wafer. Hence given considerations already taught and discussed in Hirata et al. with respect to biasing of multiple substrates, plus given above discussions of obviousness with respect to other substrate arrangements, it would've been further obvious when considering the teachings of Ohmoto et al., to combine the teachings of these two references for achieving alternative substrate arrangements with controlled ion bombardment from plasma via variably controlled biasing, including central circular substrate surrounded by one or more annular ring substrates

or the like, which might possibly be what was intended by applicants claim 14, in order to achieve desired ion bombardment distribution, inclusive of uniform bombardment of central & peripheral areas.

Also, it would've been obvious to one of ordinary skill the art to employ conventional means for securing substrates to substrate holders, especially if any substrate movement/substrate holder movement is involved in the process, in order to insure repeatability of the process due to repeatable positioning & to avoid defects or errors due to substrates getting out of place, thus use of standard substrate securing means, such as electrostatic clamps would reasonably have been expected of a competent practitioner, as a known & effective means of providing such secure holding.

10. **Hatakeyama et al**. ("Formation of alkali- and Si-Endohedral Fullerenes Based on Plasma Technology") has teachings considerably overlapping with Hirata et al. discussed above including using alkali-fullerene plasmas to caged alkali metal ions within C_{60} cages (e.g. ion implanting fullerene as discussed above, so creating fullerene-containing material), or creating Si-fullerene compounds (e.g. SiC_n where $n \geq 60$, with n = 74, 86, 94, 106, 116 & 126, indicated as "magic numbers", presumably especially stable), which appears to be relevant to possible hetero fullerene structures, hence Hatakeyama et al. ("Formation...") is considered equivalent &/or cumulative thereto for the above rejection, but redundant at this time.

Huang et al. ("$^{14}N@C_{60}$ Formation in Nitrogen RF-Plasma") is of interest for further plasma depositions with ions being implanted or caged within the fullerene compound, which refers to such procedures "preparing fullerene polymers" (second ¶), thus may be considered to substantiate above assertions with respect to polymers. **Watanabe et al**. ("Synthesis of Endohedral ^{133}Xe-Fullerene by Ion Implantation") provide further relevant teachings concerning both implantation of ions & fullerene dimer formation, as well as to fullerene-containing materials.

11. **Claims 15 & 21** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al.**, as applied to claims 1-11, 14 & 16-20 above, and further in view of **Pietzak et al.** ("Properties of Endohedral N@C_{60}").

Hirata et al. do not discuss whether or not the substrate temperature is controlled, thus whether or not the substrate may be cooled, however control of substrate temperature in order to control deposition & chemical effects are standard techniques in the physical vapor deposition art, inclusive of plasma deposition techniques, which due to ion bombardment on substrates causes energy transfer from energetic bombarding particles of the plasma to the substrate; thus plasma bombarded substrates are old and well known to be temperature controlled, such as by employing cooling means to avoid overheating. Hence, it would've been obvious to one of ordinary skill in the art to employ conventional substrate cooling techniques in the apparatus &/or process of Hirata et al., dependent on temperature sensitivity of particular substrates, deposition materials or deposition processes. For example, **Pietzak et al.** (abstract; section 2, 1st ¶, p. 613; & figure 1) was also ion implanting ions in fullerene molecules that are deposited on the substrate simultaneous with the ion implantation at higher ion currents & ion energies (50 μA & 40 eV), albeit using a different apparatus set-up than Hirata et al. & implanting nitrogen ions instead of alkali metal (i.e. K); employs water cooling associated with their deposition set up as illustrated in figure 1, hence these teachings in combination with Hirata et al. would reasonably have further suggested to one of ordinary skill in the art to employ water cooling in ion implantation procedures involving fullerene compounds, especially when higher energy implantations are performed.

Note these teachings of Pietzak et al. may additionally be considered to provide cumulative evidence for the above asserted obviousness of employing higher positive ion implantation energies for implanting fullerene deposits.

12. **Claims 12-13** are rejected under 35 U.S.C. **103(a)** as being unpatentable over **Hirata et al.**, as applied to claims 1-11, 14 & 16-20 above, and further in view of by **Yamashita Mutsuo** (JP 2003-

313662) discussed above in section 7, &/or **Hatakeyama** [et al.] ("Characteristics and Applications of Fullerene Plasmas" or "Phenomena of Steady State Discharge Plasma and Their Applications" (*formal translations supplied*)).

Hirata et al. does not discuss use of any grid electrode structured for controlling the plasma potential in their plasma column, nor its distance from the substrate, however **Yamashita Mutsuo** (discussed above) provides teachings concerning the use & effectiveness of grid electronics in controlling ion concentrations in plasma & their movement in the plasma apparatus, thus would've been obvious to employ in the apparatus & process of Hirata et al. for substantially the same reasons as discussed above in section 7. Alternatively, the **Hatakeyama** [et al.] references are both concerning plasma depositions of C_{60} ions (or allotropes thereof, e.g. carbon nanotubes) & alkali metal ions, thus are substantially analogous to Hirata et al., however the original journal articles only have abstract & figure captions in English, but Hatakeyama et al.'s figure 1(a) & Hatakeyama's figure 7(a) both illustrate apparatus substantially the same as that of Hirata et al., including direction of magnetic field (B), but additionally have a grid structure that may optionally (arrow symbol showing movement in or out of plasma column) be employed in the plasma column between the substrate & plasma+fullerene sources. In the Hatakeyama references, the illustration & nomenclature would have suggested to one of ordinary skill in the art that such a grid is an electrically conductive grid & that when inserted into the plasma column is employed for typical & conventional purposes of such electrically conductive grids. In the translation of **Hatakeyama et al**. ("Characteristics...") figure 1 is discussed on pages 3-6, which discussed creating a plasma with K ions & subliming fullerene in an oven & spraying fullerene particles into the K-plasma, with the top page for mentioning use of Langmuir probe for measurements & that "the plasma were subject to a property deterioration prevention mechanism" & the sentence bridging pages 4-5 of the translation disclosing use of "an ion acoustic wave excitation grid (Mo wires 0.1 mm diameter, 2 mm intervals) and an axial movable receiving probe", such that the illustrated & discussed molybdenum grid

is clearly acting as an electrode & positioned as claimed, with the context implied that it is employed specifically for plasma property control. In the translation of **Hatakeyama** ("Phenomenon..."), discussion relevant to figure 7 thereof is found on pages 11-15, discussing the same hot plate at a ground potential & set at five substrates DC biased at opposite ends of the plasma in the axial uniform magnetic field, however none of the discussion therein is clearly associated with the grid of figure 7(a). Therefore, the Hatakeyama references, as discussed above alone, or optionally as considered in combination with **Yamashita Mutsuo**, who explicitly shows & discusses an analogous electrically conductive grid used for control purposes in reasonably analogous plasma configurations, thus Yamashita Matsuo provides a more detailed discussion of how such grids operate, while the Hatakeyama references illustrate known use & expected effect of this of such grids when depositing & ion implanting fullerenes.

Note that Hatakeyama ("Phenomena...") provides further explanations & showings that indicate that negative substrate bias potential provides more desirable results in positive substrate potential, as indicated by the illustrations of figures 7(b) & figure 11, hence is cumulative to the Hirata et al. rejection.

13. **Claims 16-18** are provisionally rejected on the ground of nonstatutory **obviousness-type double patenting** as being unpatentable over claims 13-16 & 20-22 of copending Application No. **10/593,557 (*allowed but not yet issued*)**.

Claims 1-15 & 19-21 are provisionally rejected on the ground of nonstatutory **obviousness-type double patenting** as being unpatentable over claims 3-7 & 9-22 of copending Application No. **10/593,557,** in view of **Hirata et al**. for claims 1-13, and further in view of **Pietzak et al**. ("Properties…") for claims 14-15 & 19-21, where the references were discussed in sections 9 & 11 above, and optionally considering **Ohmoto et al**. (2001/0019881 A1) with respect to claim 14, as discussed in sections 7 & 9.

Applicants have argued on page 11 of their 8/31/10 response that inclusion of method limitations in **copending (557)** claims, concerning encapsulation of ions in fullerenes (or nanotube molecules)

removes the provisional obviousness double patenting rejection, <u>however</u> this amendment has absolutely no effect on either the apparatus or the process claims of the current application, since implanting ions inside a cage is still implanting, and methods performed in apparatus, only limit in apparatus with respect to structure, if the limitations change or necessitate some structural feature, which these limitations have no apparent structural affects. The method limitations have been removed from the obviousness double patenting rejection without secondary references & discussed with respect to prior art, due to the limitation in the present claims with respect to magnetic field orientation, which while copending apparatus claims have equivalent magnetic field means ("magnetic field generation means for transporting and irradiating said plasma to said deposition-assistance substrate", which in order to be ineffective in transporting in like configuration must have like field orientation), copending method claims are silent with respect to use of any magnetic field.

Although the conflicting claims are not identical, they are not patentably distinct from each other because Copending **10/593,557** to overlapping inventors is directed to encapsulating ions in fullerenes or nanotubes deposited on a substrate, which is equivalent to the present method claims of ion implanting deposits on the substrate that might be fullerenes (claims 6-8, no longer need to start as fullerenes, see above 112's) or nanotubes (claim 9), as the encapsulating is a form of implanting & both are depositing on substrates. Also, in both cases, a bias voltage is applied to the substrate, which voltage is of the opposite polarity of the ions bombarding the substrate, and while the copending (557) does not require the bias voltage to be DC, it would have been obvious to one of ordinary skill in the art that when the polarity of the ions & the polarity of the substrate are opposite, then the simplest means of achieving this bias relationship is to employ DC voltage applied to the substrate. It is noted that the preambles of copending (557) independent claims 1, 6 & 17-19 appear to describe a configuration employing a cylindrical vacuum vessel that has a plasma generation means at one end, with the substrate at the other end of the cylinder, so as to be "irradiating said plasma towards said... substrate", which while employing different semantics,

is considered equivalent to the present transporting & irradiating towards requirements of the present claims, except that these independent claims do not require the use of a magnetic field to influence the transportation of the plasma, however dependent claim 7 does require such a magnetic field, hence the claims are directed to overlapping scopes of processes, with limitations claimed in different orders, thus are obvious variations on the analogous processes. Dependent claims 4 & 5 of both these cases have analogous requirements for when deposition in a radiation occurs. While the copending method claims do not recite particular acceleration energies for ions being implanted or ion current densities therefore, it would've been obvious to one of ordinary skill in the art to optimize implantation/encapsulation parameters, dependent on specific materials being implanted & being implanted with, as well as desired results, such as limiting acceleration energy such that it is sufficient to implant structures such as the fullerenes & carbon nanotubes claimed by both applications, but insufficient to cause significant damage to the structure of these molecules during the implantation, which would reasonably have been expected to encompassed claim parameters given routine experimentation.

Copending (557) apparatus claims 13, 15, 16 & 20-22, all require a vacuum vessel, a plasma generation means, a magnetic field that must be capable of affecting transport of plasma & ions thereof towards the substrate, where a substrate biasing means capable of applying the appropriate polarity, thus are directed to apparatus of overlapping scope, you having semantics &/or method limitation capability differences that are not seen to provide any significantly different structural requirements. Also copending (557) has dependent claim 14 limitation to "said electric potential body comprises electroconductive wires in a lattice pattern", which while unclearly related to the (557) independent claim 13 that does not mention said body, has a descriptive structure essentially the same as the grid electrode used to control plasma potential in the present claims. As wire grids or lattices, implies conductive or biased, & are typically & conventionally employed in the plasma art for controlling the plasma envelope, hence its potential &/or extracting particular desire to components from a plasma by

judicious application of appropriate electrical potentials, i.e. voltages, given the claim of a body having electrical potential made from electroconductive wires in a lattice pattern, it would've been obvious to one of ordinary skill & competence in the art to employ such a structure for any of the typical plasma the manipulation & control procedures, such as that desired in claims 12-13 of the present application, where placement would depend on dimensions of apparatus & substrate(s), as well as particular desired results.

Copending method claims of (557) do not discuss employing a magnetic field in the plasma configuration as now claimed, however **Hirata et al**. (discussed above) is employing an analogous plasma generation & biased substrate configuration for deposition & ion bombardment that causes implantation of fullerene deposits, and explicitly discloses, discusses & illustrates a magnetic field in an orientation encompassed by present claim language, that is employed for aid of ion transportation, thus it would've been obvious to one of ordinary skill in the art to employ such a magnetic field for its taught purposes with a reasonable expectation of effectively aiding the transport of on ions for deposition & ion implantation of on ions into fullerenes (i.e. encapsulated) as claimed in the copending (557) method claims.

While these claims of copending (557) do not recite the substrate with plural divisions (e.g. plural substrates), substrate movement means, clamping means or cooling means the above discussed **Hirata et al.**, in view of **Pietzak et al**. are directed to substantially analogous processes & apparatus to those claimed by these copending claims, where as seen above, plurals to substrates having possible claimed configurations, substrate movements, substrate holding means & cooling thereof, are obvious variations on known processes as described by Hirai to et al. & apparatus therefore, hence it would've been obvious for reasons as discussed above.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

14. **Claims 1-21** are provisionally rejected on the ground of nonstatutory **obviousness-type double patenting** as being unpatentable over claims 12-19 & 21, or claims 28-29,31-33 & 36, or claims 1, 4-5, 13 & 23-24 of copending Application No. **10/581,441**, or, **11/659,201**, or **10/786,914**, respectively, in view of **Hirata et al.**, and further in view of **Pietzak et al.** (for ***claims 15 & 21***) and **Hatakeyama** [et al.] ("Characteristics …" or "Phenomena …" for ***claims 12-13***), discussed in sections 9 & 11-12 above; and optionally considering **Ohmoto et al.** (2001/0019881 A1) with respect to ***claim 14***, as discussed in sections 7 & 9.

Copending application **(441)** differs from the present claims in that the apparatus, particularly specified to be employed for production of fullerene derivatives (method used consistent & compatible with present claims) while driving positive ions onto a substrate having fullerene deposits thereon, does not particularly specified that the substrate is negatively **DC** biased, however **Hirata et al.**, as discussed above, clearly shows the advantages & desirability of such biasing in order to effect desirable positive ion bombardment of fullerenes, such that it would've been obvious to one of ordinary skill in the art to employ such biasing means to ensure effective ion bombardment, especially given analogous intended process use. It is further noted that while copending (441) discusses employing coils for generating mirror fields which control the positive ions in the plasma, the claims do not explicitly discuss use of magnetic fields, however mirror fields & coils used to produce them, are inherently employing magnetic fields, thus mirror fields & magnetic fields are limitations having overlapping scope, thus obvious variations. *It is additionally noted that the pairs of coils for generating mirror field would reasonably have been expected to create an axial magnetic field equivalent to that presently claimed (8/31/10), hence these are essentially descriptive semantics differences describing like processes & apparatus configurations. Also while copending (441) apparatus claims do not specify that the plasma generation means is a constant plasma, they specify the capability of maintaining a specific range of electron energy, thus are clearly suggestive in the requirement of maintaining, of employing a constant plasma, thus again*

are considered to be of overlapping scope & with semantics differences. It is further noted that the amendments to the independent claims in (441) are describing a control of electrode as illustrated by reference numbers 18 or 58 in figures 1- 3 & described in [0025] in (441), which are essentially equivalent to the presently claimed grid electrode, thus claiming essentially equivalent limitations with different semantics & varying scope, i.e. obvious variations.

Copending application **(201)** injecting fullerene source material into a plasma flow to where the products of the plasma are accumulated or deposited & from some sort of source object (e.g. equivalent to means for supplying ionized species, such as for creating the hetero component of hetero-fullerenes claimed in both cases) which overlaps with the present process generically with respect to plasma techniques & specifically with respect to reagents employed. Copending (201) method claims, particularly specified production of "induction" fullerenes (i.e. implanting, encapsulating, caging, injecting, etc., atoms or ions of other elements into the fullerene structure, so appear to be methods of use consistent & compatible with present claims), while accumulating "induction fullerenes" in a "recovering cylinder, which is considered equivalent of a substrate, but differ by having no limitation as to where the "induction fullerene is actually formed (i.e. encompass either within the plasma flow or on the "recovering cylinder"), where the current (201) claims do not particularly specify whether or not to be recovering cylinder is biased or not, only that plasma flow is induced, do not particularly specified employing a magnetic field during the plasma deposition process, hence considering this limitations it would have been obvious to one of ordinary skill in the art to look to analogous prior art for particular plasma generation & flow means for creating the required procedure, thus **Hirata et al.**, as discussed above, who clearly employ an equivalent plasma generation & flow process for like reagents, as well as teaching the advantages & desirability of such magnetic fields in order to control & transport the plasma. In other words, it would've been obvious to one of ordinary skill in the art to employ such magnetic field plasma control techniques to ensure effective ion bombardment and deposition ≡ accumulation of

fullerene products, especially given analogous intended process use. It is noted that in (201) the apparatus claims have been canceled, however as the present application is a 371 including both apparatus & method as not patentably distinct, thus the claims for the apparatus used to perform the method in the present claims will be considered to remain in this rejection.

Copending reissue application **(914)**, while having apparatus claims directed to claimed plasma & biasing configurations that enable relevant plasma & ion transport to a susceptor electrode (e.g. an electrode capable of holding & temperature controlling a substrate(s)), where the susceptor electrode has the same DC potential as the chamber wall, thus is equivalent to a DC biased substrate holder thus substrate & since the DC potential is applied & represents a voltage, is considered to read on a means for applying a DC voltage & for this 371 cases the method of doing so. (914) claims appear to further describe a composite structure for the susceptor electrode such that it has a plurality of metal plates concentrically configured with individual in electrical connections, which may be a structure or related to that intended for use in present claim 14. (914) also has claims to any "electrode shield" disposed adjacent to the susceptor electrode, which could describe the presently claimed configuration of present claim 12 with respect to the "grid electrode", such that these limitations are considered overlapping, but not necessarily the same. It is noted that the (914) claim of a bellows connected to the chamber implies gaseous input, although it is not standard terminology with any clear meaning with respect to a plasma apparatus. Copending (914) does not particularly specified employing a magnetic field generation means in the apparatus thus use of an axial magnetic field during the plasma deposition process, nor do these apparatus (914) claims indicate particular reagents for intended use, however what of ordinary skill the art would consider apparatus with overlapping construction & plasma capabilities for determining expected useful reagents & products to be used & formed therein, as well as what additional apparatus means would be required for such use in processing. Hence, with these considerations in mind, **Hirata et al.**, as discussed above, who clearly demonstrate the desirability, effectiveness & expected usefulness of

employing analogous apparatus for fullerene deposition & ion implantation, with means for supplying ion & fullerene reagents to such an apparatus, including vapor injection means which could be a bellows. Furthermore, Hirata et al. to show the advantages & desirability of axial magnetic fields produced by coiled means, in order to control & transport the plasma in analogous plasma apparatus; therefore it would've been obvious to one of ordinary skill in the art to employ such magnetic field plasma control techniques to ensure effective ion bombardment.

None of the claims of copending applications (441), (201) or (914), recite claimed use of an electrically conducting grid (*although (441) generically recite a means capable of the same function which in light of its specification is a grid*), or the substrate with plural divisions (e.g. plural substrates), substrate movement means, clamping means or cooling means the above discussed **Hirata et al**., in view of **Hatakeyama** or **Pietzak et al**. are directed to substantially analogous processes & apparatus to those claimed by these copending claims, where as seen above conductive grids for plasma potential control, or plurals to substrates having claimed configurations, substrate movements, substrate holding means & cooling thereof, are obvious variations on known processes as described by Hirai to et al. & apparatus therefore, hence it would've been obvious for reasons as discussed above. Also, the claims of copending applications (441), (201) or (914), do not discuss multiple substrate use or composite substrates with multiple biases, although (914) has a composite bias electrode structure that appears capable of employing as possible interpretations of present claim 14, however above discussions with respect to the obviousness of such configurations, given the teachings of Hirata et al., provide analogous obviousness with respect to these applications' claims, optionally with further consideration of alternative specific configurations & biasing techniques as suggested by **Ohmoto et al**. (881) as discussed above.

Also, copending claims have varying limitations with respect to ion parameters (e.g. density & acceleration energy), however above arguments concerning dependence on particular material & routine and experimentation, are also relevant here.

These are provisional obviousness-type double patenting rejections.

15. **Other art** of interest includes: **Ohmoto et al**. (7,608,162 B2) discussed above; & **Chow et al**. (7,750,297 B1), which while not prior art is interest to the state-of-the-art with respect to ion implantation of carbon structures, specifically carbon nanotubes.

Other art of interest previously cited included: **Ueba et al**. (5,538,763), **Bhushan et al**. (5,558,903) & **Yamada et al**. (6,416,820 B1), providing further teachings on ion implantation techniques with respect to relevant materials such as fullerenes &/or carbon nanotubes; and **Buckley et al**. (2007/0243315 A1) or **Hanley et al**. (2004/0247796 A1), also using ion assisted deposition processes for relevant fullerene derivatives for electrochemical cell parts, or conductive polymers for solar cells, respectively.

16. Applicant's arguments filed 8/31/2010 & discussed above have been fully considered but they are not persuasive.

Additionally, besides the above discussion of the rejection based on Miyake Koji et al., the examiner notes that applicants argue with respect to Koji had all been directed to a different purpose, however applicants independent claims are completely generic with respect to purpose, such that they are indistinguishable from the purpose of Koji et al. Applicants further argue with respect to inefficiency & enabling high density ion implantation, but nothing in any of applicant's claims are directed to high density ion implantation, while inefficiency or implantation rate considerations is addressed in the 103 rejection above.

With respect to Hirata et al., applicants' arguments are entirely ineffective, as the claims as written encompass the process as taught in this literature reference. Applicants' discussed that in the present invention, fullerene is injected towards the substrate so as to deposit a fullerene film, however nowhere do they claim any such process & furthermore Hirata et al. is also injecting fullerene vapor & deposit a filmed thereof, noting that their fullerene vapor is ionized is irrelevant, both to applicants' claims

& to applicants' arguments, since an ionized vapor is still a vapor. Also applicant claims encompass injecting deposition material into the plasma (simultaneous deposition from apparatus illustrated in figures 1 & included in the claimed scope, where whether or not that deposition material is vaporized fullerene, it would reasonably expected to also become ionized.

17. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

18. **Any inquiry** concerning this communication or earlier communications from the examiner should be directed to **Marianne L. Padgett** whose telephone number is **(571) 272-1425**. The examiner can normally be reached on M-F from about 9:00 a.m. to 5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-

direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Marianne L. Padgett/
Primary Examiner, Art Unit 1715

MLP/dictation software

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